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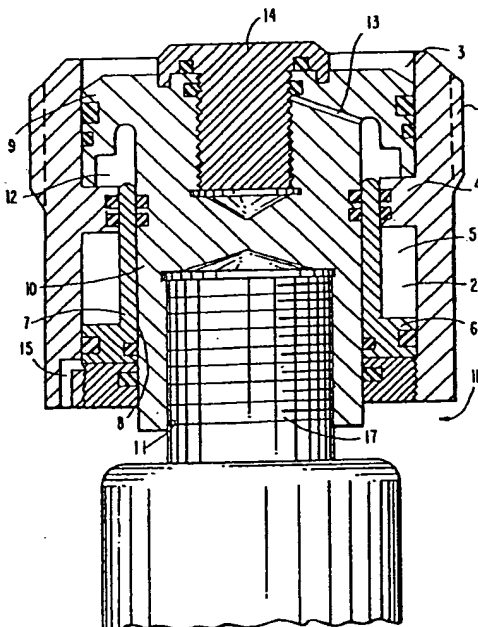
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(54) Hydraulic bolt tensioner

(57) A hydraulic bolt tensioner, having a first chamber (5) and a second chamber (12), a hollow first piston (6,7) movable in the first chamber (5) and partially extending into the second chamber (12), a second piston (9,10) displaceable inside the first piston (6,7) and movable in the second chamber (12), the second piston (9,10) having connecting means (11) for connecting with an end of a bolt (17), and a hydraulic fluid supply for supplying hydraulic fluid into the first chamber (5) so that, when hydraulic fluid pressure is applied to the first chamber (5), the first piston (6,7) moves so that the first piston displaces the hydraulic fluid in the second chamber and moves the second piston (9,10) to pull the end of the bolt.



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## Description

This invention relates generally to hydraulic tools for tightening threaded connectors or, in other words, to hydraulic tensioners.

Hydraulic tensioners are widely known and utilized. It is desirable to design such a hydraulic tensioner which has a relatively low power consumption. In connection with this a hydraulic tensioner has been proposed in WO94/14578 having a bolt pulling means which includes an engaging element arranged to engage the end of the bolt, fluid operated means formed by a plurality of cylinders arranged on top of one another along the axis of the engaging element and having cylinder chambers, and a plurality of pistons axially movable in the cylinder chambers. The cylinder chambers and the pistons movable in them are coextensive and substantially identical. The pistons simultaneously apply a pulling force to the same engaging element which pulls the bolt and a higher pulling force is generated with a predetermined power consumption from the hydraulic source or the same force applied for pulling the bolt is produced with a lower power consumption of the hydraulic source. The engaging element pulls the bolt, and additional fluid-operated means turn the nut down when the bolt is pulled to a desired load.

However the bolt tensioner disclosed in WO94/14578 has the disadvantage that in order to keep its diameter small, several cylinder stages are required which in turn make the bolt tensioner substantially high. While in some applications height is not important, there are other applications where the overhead clearance is limited so that the above described tensioner cannot be used.

It is therefore an object of the present invention to provide a hydraulic bolt tensioner which avoids the disadvantages of the prior art.

In keeping with these objects and with others which will become apparent hereinafter, one feature of the present invention resides, briefly stated, in a hydraulic bolt tensioner, which has means forming a primary chamber and a secondary chamber; first hollow piston means displaceable in the primary chamber and having a portion extending into the secondary chamber; and second piston means provided with connecting means for connecting to a bolt end and displaceable in the secondary chamber, so that when hydraulic fluid pressure is applied to the primary chamber the first piston means moves so as to displace the hydraulic fluid in the secondary chamber and to move the second piston means to thereby pull an end of the bolt.

When the tool is designed in accordance with the present invention, it avoids the disadvantages of the prior art and provides for the highly advantageous results.

When the hydraulic bolt tensioner is designed in accordance with the present invention, with the use of a regular industrial hydraulic pump which usually provides the maximum pressure of 68,947KPA (10,000 psi),

three times the pressure can be developed in an independent chamber which is connected to the bolt tensioner. The height of the tool is reduced by 50% and the diameter of the tool is equivalent to the diameter of the tool disclosed in WO94/14578.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings, the sole figure of which is a view showing a hydraulic bolt tensioner in accordance with the present invention.

A hydraulic bolt tensioner in accordance with the present invention has a housing which is identified as a whole with reference numeral 1. The housing 1 is hollow and has a stepped inner opening with a first opening portion 2 and a second opening portion 3 separated from one another by an inwardly projecting partition 4.

A first substantially cylindrical hydraulic chamber 5 is formed in the region of the opening portion 2. First piston means cooperate with the first hydraulic chamber 5 and include a tubular first piston 6 which is axially displaceable in the first chamber 5, and an elongate axially extending tubular piston extension 7. The first piston means 6, 7 are hollow and have an inner opening 8. Second piston means include a piston 9 which is axially displaceable in the opening portion 3 and an elongate axially extending piston rod 10 which is axially displaceable in the opening 8 of the first piston means.

The second piston means, or in particular the piston rod 10 of the second piston 9, has a central opening 11 provided with a thread for engaging with a thread of a bolt to be tensioned. A second substantially cylindrical hydraulic chamber 12 is formed substantially between the first piston means and the second piston means. As can be seen from the drawing, the second hydraulic chamber 12 is formed between the piston rod 7 of the first piston means 6, 7 and the piston 9 of the second piston means 9, 10.

The second cylinder chamber 12 is filled with oil through passages 13 which after filling can be closed by a filler plug or bolt 14. The first cylinder chamber 5 during operation is supplied with a hydraulic fluid from a hydraulic source, for example from a regular industrial hydraulic pump, through a supply passage 15. A nut turning portion of the tool is identified as a whole by reference numeral 16 and operates for turning the nut applied on the bolt. The nut turning portion 16 can be formed completely identically to the nut portion disclosed in WO94/14578 or in any other way.

The tool in accordance with the present invention operates in the following manner:

When the hydraulic fluid is supplied from the hydraulic fluid source to the first chamber 5, the first piston 6 is displaced and its tubular piston extension 7 displaces the hydraulic fluid in the secondary chamber 12.

Thereby the second piston 9 with the piston rod 10 is displaced and pulls the end of a bolt 17.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of constructions differing from the types described above.

While the invention has been illustrated and described as embodied in a hydraulic bolt tensioner, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the present invention.

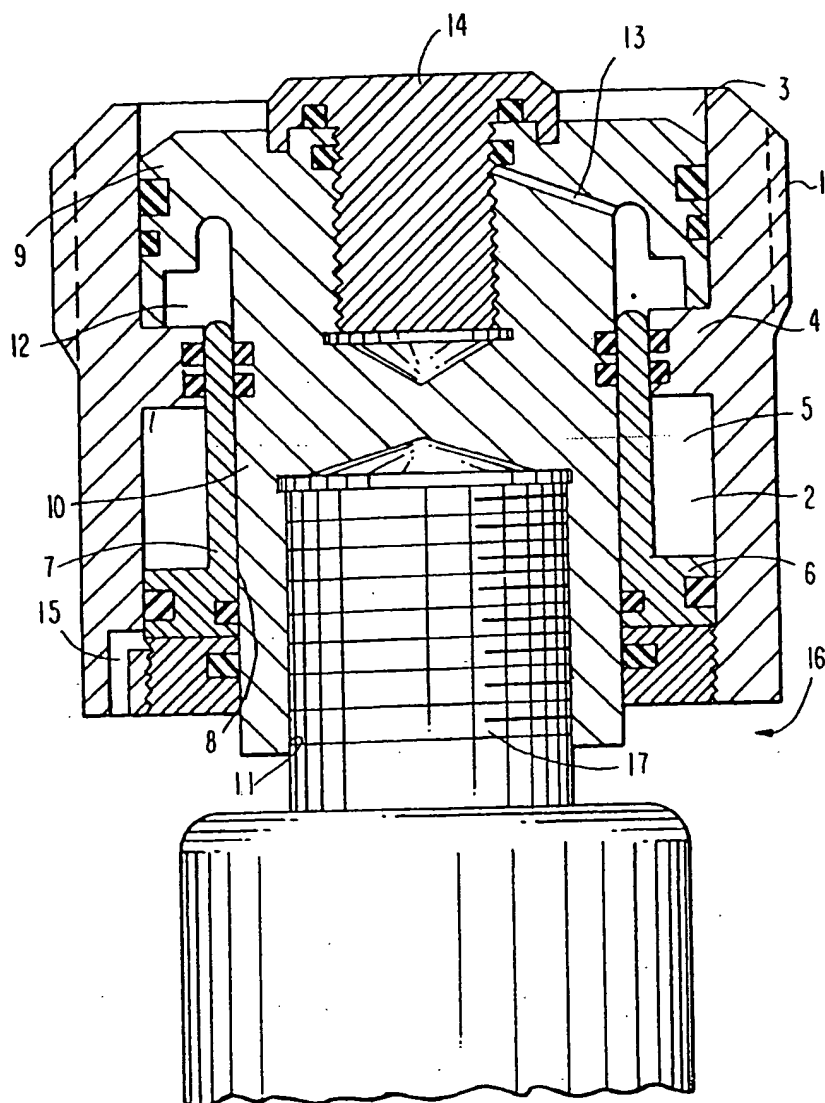
Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention.

#### Claims

1. A hydraulic bolt tensioner characterised in that it comprises means forming a first chamber (5) and a second chamber (12), hollow first piston means (6,7) movable in said first chamber (5) and partially extending into said second chamber (12), second piston means (9,10) displaceable inside said first piston means (6,7) and movable in said second chamber (12), said second piston means (9,10) having connecting means (11) for connecting with an end of a bolt (17), and means (15) for supplying hydraulic fluid into said first chamber (5) so that when hydraulic fluid pressure is applied to said first chamber (5), said first piston means (6,7) moves so that said first piston means (6,7) displaces the hydraulic fluid in said second chamber (12) and moves said second piston means (9,10) to pull the end of the bolt.
2. A hydraulic bolt tensioner according to claim 1, characterised in that said first chamber (5) has an area to which the pressure of hydraulic fluid is applied and which is greater than an area of said second chamber (12) to which the pressure of the hydraulic fluid is applied.
3. A hydraulic bolt tensioner according to claim 1 or 2, characterised in that said first piston means (6,7) include a tubular first piston (6) movable in said first chamber (5), and a tubular first piston extension (7) extending from said first piston (6) into said second chamber (12).
4. A hydraulic bolt tensioner according to any of claims 1 to 3, characterised in that said second piston means (9,10) includes a second piston (9) movable in said second chamber (12) and a second piston rod (10) extending from said second piston

and provided with said connecting means (11).

5. A hydraulic bolt tensioner according to any of the preceding claims, characterised in that said second chamber (12) is formed substantially between said first piston means (6,7) and said second piston means (9,10).
6. A hydraulic bolt tensioner according to any of the preceding claims, characterised in that it further comprises a housing (1), said first chamber (5) being formed between said housing (1) and said first piston means (6,7).





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# EUROPEAN SEARCH REPORT

Application Number  
EP 95 30 8058

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	DE-A-22 38 974 (MASCHINEN- UND WERKZEUGBAU GMBH) * page 8, line 5 - line 18 * * page 9, line 15 - line 22; figures 3,4 *	1	B25B29/02
A	FR-A-2 308 758 (MESSIER-HISPANO) * page 7, line 20 - line 28; figures 7,9 *	1	
D,A	WO-A-94 14578 (UNEX CORPORATION) * abstract; figure 1 *	1	
A	GB-A-1 179 027 (LICENTIA PATENT-VERWALTUNGS-GMBH) * page 1, line 10 - line 35; figures *	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			B25B B23P F16B
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
THE HAGUE		23 April 1996	Majerus, H
<p><b>CATEGORY OF CITED DOCUMENTS</b></p> <p>X: particularly relevant if taken alone  Y: particularly relevant if combined with another document of the same category  A: technological background  O: non-written disclosure  F: intermediate document</p> <p>T: theory or principle underlying the invention  E: earlier patent document, but published on, or after the filing date  D: document cited in the application  L: document cited for other reasons  A: member of the same patent family, corresponding document</p>			

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